

WHY AREN'T WOMEN STICKING WITH SCIENCE IN TAIWAN?

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This paper explores the factors that contribute to the “leaky pipeline” in science, technology and medicine in Taiwan. The term “leaky pipeline” refers to the steady attrition of women throughout their careers in science, technology and medicine—fields in which men constitute the majority. As a result of this attrition, women are under-represented in the top positions. This phenomenon has been well studied in the United States, and based on the available data in the Chinese and English-language literature, this paper focuses on: (1) the social-cultural factors that keep young women away from science and medicine; (2) the difficulties faced by woman scientists when trying to balance work and family responsibilities; and (3) the impact of the pervasive masculine culture on training and promotion in career development. Conclusions include suggestions for improvements for equality between the sexes in science education, family responsive policies, and institutional reform.

Key Words: careers, gender, leaky pipeline, masculinity, stereotypes
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“Successful male scientists tend to attribute their achievement to their ability and effort, whereas female scientists attribute it to luck.” (Note made by a male medical doctor at the International Conference on Women Scientists in 2009)

The powerful metaphor of a “leaky pipeline” has been embraced by sociologists, science educators, scientific communities and policy-makers in the United States since its first use in the early 1990s [1,2]. It has also been adopted by the European Commission [3] since gender mainstreaming was promoted by the United Nations in 1995. The metaphor is used to refer to the steady attrition of women throughout the education system and professional hierarchy, with the result that more women are gathered in lower positions and under-represented at the top. As such, the metaphor vividly captures the anxiety of losing gifted woman scientists, and the aspiration for gender equality in the science community. In the United States,

physics, engineering and technology are the fields in which the pipeline leaks most seriously, and medicine and life sciences are at the end with a lesser degree of leakage [4]. This is also the case in Taiwan (Figure) [5].

Taiwan is a latecomer in terms of research and policy-making aimed at dealing with the issue of the loss of women scientists in science and medicine. Similar to the United States and European Commission, two related actions have been taken by gender equality communities in Taiwan. One is to attract the attention of researchers to the complicated multiple factors that cause pipeline leakage; the other is to urge the government to allocate resources to science education to fix such leaks. In the latter case, the National Alliance of Taiwan Women’s Associations initiated a series of activities in ‘The Project for Nurturing Ms. Science’ in 2007, and the National Science Council has allocated resources for the International Conference on Women Scientists (ICWS) since 2008 [6,7]. These activities aim to attract girls from senior high schools who are interested in science as well as junior women



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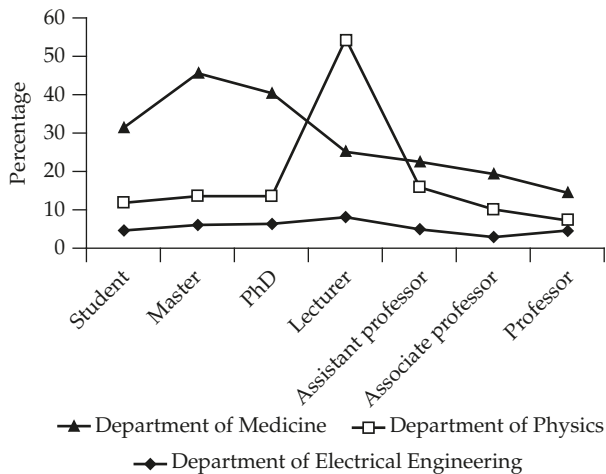


Figure. Female academic staff in medical, physics and electrical engineering departments in Taiwan, January 2010. Adapted from [5].

scientists who are already in the trade. The idea is that the presence of women scientists as role models should send a positive message to young women that they too can become successful and confident scientists; the presence of the young scientist also serves to argue against the misconception that science is unattractive to women and should be avoided [8]. The value of the events is that they create a friendly environment for potential young women scientists to boost their confidence and eliminate their self-doubt. The need to present role models for girls and women in career development is one of many factors suggested by researchers [8]. However, Sonnert points out that science careers are shaped by “numerous idiosyncratic events and characteristics that are often insignificant by themselves but become forceful in their accumulation” [9]. Despite the fact that it is hard to measure their effectiveness, presenting role models to young girls and junior scientists is at least a manageable step towards fixing the leaky pipeline. Thirty years of research findings are now reviewed.

LITERATURE REVIEW

A large number of English-language studies have been carried out over the past 30 years. Sonnert and Holton have used both the deficit and difference models to try and offer an explanation. The deficit model emphasizes the structural barriers—legal, political and

social—that give fewer opportunities to women. The difference model refers to the notion that women act differently from men, either via innate gender difference or cultural determination as a result of socialization and acceptance of their gender role and value. In reality, these two models have always been intertwined [10].

Some scientists still might have deep-seated beliefs that gender differences are innate; thus the performance of women in certain areas in science is inferior to that of men. Lesley Rogers in her famous book, *Sexing the Brain*, has provided sufficient scientific evidence to refute the absurdity of innate determinism [11]. This was also been echoed in a report in 2006 by the Committee of the National Academy of Science in the United States, in which theories that advocate a gender difference in such areas as cognitive ability or preferences, career aspirations and ambition, are criticized as having no scientific foundation [12].

The science educator Blickenstaff carried out a literature review in an attempt to explain the absence of women in science, technology, engineering and mathematics over the past 30 years. He found that some explanations in the research literature are without merit, such as those that refer to biological differences between men and women, or girls’ lack of academic preparation for a science career. However, he found that other factors do exert some influence, and that there is a complicated interaction at play. These factors include the absence of women scientists/engineers as role models, an unwelcoming atmosphere for girls/women in science classes or workplaces, and cultural pressure on girls/women to conform to traditional gender roles. He goes on to suggest that the very nature of science, with its masculine worldview contributes to the leaky pipeline [8]. Sandra Harding similarly questions the political nature of scientific and medical inquiry [13,14].

The factors discussed by Blickenstaff fail to show the influential role of the family in this issue. However, this has been repeatedly mentioned by Taiwanese women scientists and physicians in their own biographical notes [15], as well as girls and junior women scientists who attended the ICWS in 2009. It is also well supported by the research of Cheng [16].

In terms of the masculine culture in science and technology, Wendy Faulkner has pointed out that technology has a gender bias because men hold the dominant position in most cases. The cultural image held

by the general public also designates technology as masculine, despite some mismatch between impression and practice. Most men form their masculine identities via working or playing with technology [17].

Elianne Riska has studied the medical careers of American, Scandinavian and Russian women physicians and has found a common pattern in these countries: "The higher up the echelons of academic and administrative structure of medicine," she writes, "the lower the representation of women". Riska also suggests that a focus on gender as a structure and institution can address the conformity and resistance of women in dealing with the stereotypical gendered images of women physicians. She also points out that we cannot homogenize women in medicine and have to recognize the differences that exist among them [18].

However, there is only limited data available on gender and science in Taiwan. As a result, this paper examines three factors that contribute to the girls and women not pursuing a career in science: (1) the barriers that prevent girls pursuing a career in science and medicine; (2) the burden of family responsibility mainly being on women due to the gender division of labor; and (3) pervasive masculine culture at work.

DATA AND METHODS

The following arguments are based on four kinds of data: (1) In-depth interview of nine medical undergraduates, medical postgraduates, and women medical practitioners in 2008–2009; (2) Discussion notes taken by the leaders of 10 workshop groups (seven for high school girls and three for junior women scientists); each of which consisted of 25–30 participants at the ICWS in 2009; (3) Data from 25 monthly newsletters, "Taiwanese Female Scientists and Technologists" 2008–2009, and The Project for Nurturing Ms. Science'; and (4) Published studies on related subjects in English and Chinese. The data were triangularly analyzed and compared in order to present the analyses in an appropriate social context [15,19].

What keeps girls away from science and medicine?

Empirical studies have suggested that the unequal educational opportunities for boys and girls are derived from patriarchal and patrilineal systems [20–22]. Thus,

when it comes to investment in education and the family future, parents favor sons over daughters because the former are seen as the inheritors of the family line, and they depend on their sons to support them in old age. Therefore, investment in boys' education, skills and other abilities are likely to enhance the parents own chances of survival [20].

Men in a patriarchal and patrilineal society such as Taiwan are expected to take responsibility for raising their own family and looking after their parents in old age. Consequently, a significant way for men to demonstrate masculinity is through their ability to earn money or equivalent social status. Both of these can be achieved through a career in the scientific, technological and medical professions, which is one of the main reasons for the popularity of such careers among young men. Things are different for young women. In a less affluent family, they are unlikely to be given the chance to attain a level of education equal to that of their brothers, let alone 7 years of training in medicine. In the case of low-class families, daughters are only educated as far as is necessary for them to get a job outside the household and bring in a wage which is then re-invested over the longer term in their brothers' higher education [20,21].

As Parish and Willis have observed, the rapid economic development in Taiwan has lead to families having more savings. Moreover, social welfare has improved and sons and daughters are able to achieve more equitable education [23]. We can probably assume that more parents from the middle class in Taiwan invest equally in their daughters and sons for more costly medical education. Therefore, the gender equality in family investment in education for science and medicine has become class-differentiated.

The traditional gendered stereotypes die hard; most parents accept the gender stereotype of jobs in considering the future of their children. This was repeatedly expressed by high school girls who participated in the ICWS in 2009, as well as by the older generations that I interviewed over 10 years ago [16]. One girl in a group discussion at the ICWS conference September 2009 pointed out: "Family is an important factor in determining the direction for a girl's future. My parents have prepared me to do music at the university, but I found science more interesting". One girl from a senior high school spoke up in a group discussion: "More boys than girls choose to do science; my family also expects girls to do business rather than science,

however, in order to prove I can do science well, I enrolled in the science classes, now it is obvious that not all boys can get better marks than girls in science."

The gender stereotype also forms peer pressure as well as teachers' attitudes in the classroom. One girl at the ICWS conference 2009 expressed an unpleasant experience due to peer pressure: "I am good at science in the school, but I am treated as strange and odd." Several undergraduate students in medicine expressed their worry as they were interviewed by the author in May 2008: "Our male classmates often criticize us behind our back for behaving like muscular men." The typical stereotype for women undertaking non-traditional career paths, such as science and medicine, does sometimes undermine the self-esteem of young girls. Only those who can pluck up the courage to challenge the view of 'girls do, girls don't' and assert their interests are able to have a career in science and medicine.

Work and family balance for women in science and medicine

One of the major issues raised among young girls and women scientists who participated in the ICWS in 2009 is how to balance work and family. This has also attracted a lot of research and lead to policy reform in the United States. Holmes and O'Connell have pointed out that family responsibilities, such as caring for children or elderly relatives, is the main reason for women abandoning academia in science, whereas the main reason for men is an uncertain job market [24]. A study conducted by Goulden et al at University College Berkeley has confirmed that family formation "accounts for the large leaks in the pipeline between PhD receipt and the acquisition of tenure for women in science." [4].

The lack of data in this respect in Taiwan have led us to rely more on quantitative data, such as the views expressed by junior women scientists who participated in the ICWS in 2009, and women doctors with young children interviewed by the author in June 2008 [17]. In fact, motherhood always seems to be the main reason among women for career stagnation or leaving the profession. One junior women scientist at the ICWS conference in 2009 has reflected on the self-imposed impression of "perfect" motherhood that became a constraint on her career development, and it was only after her children had grown up that she was able to

pursue a PhD. For many women medical practitioners, their career development has been much slower than that of their male colleagues, as clearly illustrated by one psychiatrist in her mid-30s as interviewed by the author in January 2009: "After returning home, male doctors—like my husband, for instance—can still concentrate on reading and writing research papers, but we women cannot. Our concentration is disrupted by various demands from children, cooking and shopping. Nowadays, unlike the older generation, many young men will do a share of the housework. However, the reality is that I am the one doing all the planning, arranging, and coordinating. In the short term, within the next 10 years, I know that in terms of my academic and clinical achievement, I am not able to compete with my male colleagues." Like many working women in Taiwan, women scientists and medical doctors, in facing increasing pressure for academic publications, reallocate the family burden onto other women, such as mothers or mothers-in-law, or employ domestic workers from Southeast Asia [15,22,25].

Masculine culture and career development

Some science disciplines are more masculine than others. Here, 'masculine' refers to the numerical dominance of men, the perception of the disciplines by the general public, and the hegemonic masculinity expressed in the culture and institutions of the disciplines [26].

Masculine culture permeates the laboratory and workplace, and even in social occasions after work. It could create a hostile environment in which some women feel isolated and intimidated, and their self-confidence is weakened [27]. Han has conducted a field study in electronic engineering research laboratories, and has emphasized the manner in which young men build strong bonds through playing basketball, cracking dirty jokes, sharing pornographic films and books, and participating in drinking games. However, many young women find it awkward to participate in these activities and gradually become marginalized, which seriously limits their information exchange, academic discussions, and network formation that are vital for academic development [28].

Masculine culture is also embedded in a competitive medical system, especially in top teaching hospitals. Take resident posts as an example. These are extremely hard to come by, and in most specialties, the promotion system ensures that competition for them

sharpens as post-holders work their way up the career ladder. Thus, while there may be eight places in the first year of training for a specialty, there will be perhaps only five in the second year, three in the third year, and only one place at the top of the pyramid [16]. A women physician in her mid-30s has revealed in an interview by author in May 2009: "As I reached the third resident year, my husband had just joined me for residency training in the same section. I was then voted out. Evidently, the professors believed that my husband could secure my livelihood, so the post should be given to other male colleagues who had wives to care for. I think the most difficult stage in a woman doctor's career development is the residency and sub-specialty training."

A women psychiatrist has revealed a similar predicament in an interview by author in November 2008: "Psychiatry is the specialty on the less masculine end in the hospital. However, I have been the only woman there (in this section) for the last 8 years. I was lucky enough that a vacancy appeared that year for adult psychiatry, otherwise, I probably would be forced to do child psychiatry as the senior professor kept on pressurizing me to choose the latter, which in his view, was suitable for female not male physicians. The permeated misogyny in the hospital compels me to contemplate leaving" (unpublished interview note) [38].

The professional career track is a masculine (and sexist) one, regardless of whether you are a man or woman. If a women scientist could have a wife, we might be able to speak of a level playing field. As things are, it is not surprising that achievement-seeking causes so much anxiety. The game is played according to rules based on gendered social arrangements and a widely shared masculine professional culture. These are the rules of the male game that are derived from a male life cycle uncluttered by family responsibility, and ably supported by a nurturing wife. This explains why not many women have the career aim of being promoted to head of section or other positions of responsibility, when they are still at the stage of child rearing.

Fixing the leaky pipeline

In this paper, three social-cultural aspects were chosen for understanding the leaky pipeline in science and medicine in Taiwan; however, there are also institutional factors that influence the formation of masculine scientific and medical communities. These include the peer review system, evaluation criteria,

and the academic and professional hierarchical system. Based on the above discussion, I have derived some suggestions for fixing the leaky pipeline which, though not comprehensive, should be taken into account by policy makers and university leaders, as well as people working in scientific and medical communities.

First, it is vital to change the perception of gendered stereotypes, which as discussed above, has put constraints on girls and women scientists from parents, schoolteachers, and peers, as well as supervisors and male professors, and above all, girls and women scientists themselves.

Second, it is important to implement thoroughly family responsive policies because some of them have been written into laws in Taiwan. Women academics and researchers have an extra 2-year allowance for giving a birth when their performance is evaluated by the National Science Council [29]. The paid maternity leave, the benefits of breastfeeding, as well as the need for lactation rooms and parental leave are also written into the Gender Equality of Employment Act, revised version 2008 [30]. These changes can be attributed to the hard work of feminist non-government organizations, advisors for gender equality in various ministries, and some feminist members of parliament. The family responsibility policies adopted in the past few years have provided relief for many young women, especially those in science and medicine.

Third, the systems for evaluation, promotion, and grant allocation need to be reviewed, especially in the universities. The peer review and professional evaluation of the selection process should be monitored from a gender equality perspective. An example of this can be seen with United States National Institute of Health's Pioneer Award. In order to encourage women to apply for this award, the Institute accepts self-nominations rather than institutional submissions and spends more time training its reviewers [31]. As far as evaluation and promotion in universities are concerned, it is better to provide multiple tracks rather than to rely solely upon publications and grant allocation, so that there are more channels for women and men to find their own niches for career development. The more institutional improvement there is along the line of gender equality, the more it is then expected that masculine culture will gradually diminish in power. However, sexist and chauvinistic attitudes are pervasive in Taiwanese/Chinese culture, and regrettably, are deeply entrenched even amongst young

Taiwanese men at the university level. Effecting such change is a formidable task, but the three social-cultural aspects as discussed here is just a beginning for better understanding why women aren't sticking with the science in Taiwan.

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什麼使得科學界和醫學界的女性人才流失？

成令方

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本論文探討的主題是什麼因素造成台灣理工和醫學領域中的「漏管」現象。「漏管」是特別指以男性為主的理工醫領域中，女性人才在往高層的生涯發展過程中一路流失，結果造成位高權重的女性非常稀少。這現象已經有很多研究，本論文根據已有的英文文獻以及台灣現有的研究資料，分成三個面向來討論造成「漏管」的現象：（1）探討年輕女孩子不選擇理工醫領域的社會文化因素。（2）年輕女科學家與女醫師遇到工作與家庭不易平衡的困境。（3）職場中瀰漫的陽剛特質對女性生涯發展的影響。結論是綜合這三個面向的內容，提出我們可以在科學教育，支持家庭的政策，制度設計往性別平等的方向進行改善，以減少「漏管」流失的女性人才。

關鍵詞：科學，性別，「漏管」現象，刻板印象，陽剛特質
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